

Snout thick, projecting, no pores or lateral lobe; mouth transverse, inferior. Upper lip deeply fimbriated. Lips reflected from off both jaws which have sharp edges, but no horny covering. Rostral barbels two-thirds as long as orbit.

Fins.—Dorsal commences midway between the snout and the posterior margin of the base of the anal. Caudal deeply forked, upper lobe the longest.

Lateral line:— $3\frac{1}{2}$  rows of scales between it and the base of the ventral fin.

Colours.—Silvery, apparently a dark stripe along the middle of the side.

Habitat.—Hooghly.

[*To be continued in the next number.*]

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NOTES ON TERRESTRIAL MOLLUSCA FROM THE NEIGHBOURHOOD OF MOULMEIN (TENASSERIM PROVINCES), WITH DESCRIPTIONS OF NEW SPECIES,—by DR. F. STOLICZKA, *Palæontologist, Geol. Surv. of India; Hon. Secy. Asiat. Soc. Bengal.*

(With 8 plates.)

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The following observations are offered on a small collection of Mollusca made, during the month of August 1869, in the neighbourhood of Moulmein, Tenasserim Provinces. It is not my intention to give a complete list of all the shells which have been described from that neighbourhood,—though such may at some future time prove to be a very desirable acquisition,—but merely to restrict my remarks to those species which I have myself collected, particularly with reference to some points in the anatomy of the animals.

The land shells of this part of the Malayan country received early attention through the collecting zeal of the Rev. Dr. Mason, Capts. Sankey and Gordon, Mr. Theobald and many others. The materials have been chiefly worked out by Dr. A. Gould, Mr. Benson, and Mr. Theobald.

The fauna in general is intimately connected with that of the lower Tenasserim Provinces, Siam and Camboja, and is in the main characteristically Malayan. As regards variety and number of terrestrial Mollusca, these provinces are well known to range among the richest of the Malayan regions. The interest of this fauna is besides considerably increased by the many peculiar forms it possesses of its own, and which do not appear to occur in other parts of the great Malayan Zoological province. I only need to allude to genera like *Pollicaria* (= *Hybocystis*), *Raphaulus*, *Clostophis*, *Sophina*, *Sesara*, &c. The explanation of this peculiarity must probably be sought in the physical condition of the country. Indeed, it would seem that scarcely anywhere could more favourable conditions for the development of small local faunas be found, than exist in the neighbourhood of Moulmein.

Almost all round this place the country consists of isolated hills, or short ranges of hills, composed of sandstones or shales, or more commonly of limestone rock. Many of these hills rise up to elevations of from 2000 to 3000 feet above the level of the sea, and are separated by low land which, for a large portion of the year, is under water. The rocks in question, forming the hills, mostly appear to belong to palæozoic (chiefly carboniferous) formations, and it seems probable that for a long period the country was not affected by any very considerable change in the level. On the other hand, it can scarcely be doubted, that at no very distant geological period those hills represented as many isolated islands in an extensive bay, a physical condition similar to that of the present Mergui Archipelago. The shallow waters between the hills were only gradually reclaimed to dry land by alluvia derived from the more elevated surrounding country. Whatever progress these conditions may have attained, it appears tolerably certain, that the isolation of the hills must have existed during a considerable length of time, and there is also no apparent reason for believing, that the fauna, existing on these hills, had been much affected by any particularly destructive agencies; moreover the insular conditions must have been rather favourable to animal and vegetable life.

All these circumstances tend to shew that the fauna of these hills has existed for a long period, and that at the same time the pro-

tracted isolation admitted of the development of certain persistent peculiarities of the animals in different localities. With regard to the first point, it is a noteworthy fact that most of the cretaceous species of *Helicidæ*, and a large number of the older tertiary ones, belong to the *Angystoma* group which is so largely represented in this part of the Malayan province. With regard to the second point, it must be remembered that the nature of the ground is a most important agent in the development and prosperity of the molluscous (and any other) fauna (or flora); it regulates to a very large extent the geographical distribution of the species. It is well known that limestone ground is more suitable to the existence of land-shells, than any other kind of rock. In the neighbourhood of Moulmein this is strikingly apparent; for while some of the limestone localities literally swarm with shells, there are barely any to be found on the neighbouring sandstone or metamorphic hills, which in other respects possess a perfectly similar climate, &c.

The distinction by no means only applies to the number of specimens, but it affects equally markedly the habitat of certain species, and even genera. Thus, for instance, there is scarcely a single specimen of a *Plectopylis achatina* to be met with on a sandstone hill, while at every limestone rock the species may be collected in thousands. The same applies to *Plectopylis cyclaspis*, though this species is not so common as the former. All the known species of *Sophina*, nearly all the *Sesara*, several peculiar *Streptaxis*, *Raphaulus*, *Pollicaria* and others only occur on limestone ground, while *Rotula anceps*, *Helix* [*Fruticicola*] *similaris*, and chiefly also the species of *Helicarion*, occur on sandstone hills and low land. Again some species, like *Macrochlamys honesta*, *Conulema insula* (var. *attygia*), *Mycrocytis molecula* are to be met with almost everywhere, but specimens occurring on limestone localities always possess a more solid and thicker shell, than those on sandstone, or on alluvial ground. The knowledge of the nature of the ground is, therefore, a very important consideration in discriminating species and mere varieties of one and the same species from each other. In the course of my descriptions I shall notice several instances which bear upon this point.

That the protracted isolation of the different limestone hills had

an influence upon the development of locally, and now persistently, distinct forms, which evidently descended from a common stock, will best become evident from a few instances, which are worthy of record.

At Moulmein about the great Pagoda occurs a species of *Cyclophorus* which Mr. Theobald called *C. Haughtoni*. The specimens are generally lighter or darker brown, and, except on the keel, unspotted. At the 'Farm-caves' the same species occurs, but always marked with numerous white spots, and at Damotha a third form is met with, being generally somewhat smaller and higher, and provided with small pale spots or reticulated streaks; this form has been named by Mr. Theobald *C. affinis*. Again, at the 'Farm-caves' occur in great abundance *Sophina calias* and *discoidalis*, *Sesara pylaica*, *Clausilia Philippiana*, *Streptaxis Sankeyanus*, *Pollicaria grvida*, *Raphaulus chrysalis*, &c., none of which are found on a perfectly similar limestone hill at Damotha, barely 15 miles distant from the former. There we find *Sophina forabilis*, *Sessara infrendens*, *Georissa liratula*, *Diplommatina carneola*, *Rhiostoma Haughtoni*, and other peculiar forms, &c. South of Moulmein, again on similar limestone hills, occurs *Sophina conjungens*, while *calias* and *discoidalis* are rare, *Streptaxis obtusus*, &c., but not a single *Pollicaria* or *Raphaulus* or *Rhiostoma*. Again at another limestone hill on the Attaran river there is only a peculiar banded variety of *Sophina discoidalis* to be found, *Strept. Sankeyanus* is replaced by the allied *Strept. Hanleyanus*, *Sesara pylaica* by *Sesara Attaranensis*, Theob. &c. I could multiply the examples, but those quoted will indicate that the molluscous fauna of each limestone hill, or range of hills, possesses certain forms representative of, or allied to, others which occur on a neighbouring hill, while at the same time it has a certain number of local, peculiar, species. This is a condition which we are generally accustomed to find on small separate islands within an Archipelago.

In conclusion I may observe that the present communication contains species of both of the large divisions of pulmoniferous Mollusca, the CYCLOSTOMACEA and the HELICACEA. It will be noticed that the work is somewhat unqually executed, but it is done so with a certain object.

In the CYCLOSTOMACEA I have described several new species, and of others, which were met with, I have only noted the external characters of the animals or shells. I have avoided going into anatomical details here, because I hope to place them on record in a contemplated Monograph of the Indian and Burmese CYCLOSTOMACEA, to be published with the co-operation of Mr. W. T. Blanford.

Among the HELICACEA, or PULMONATA, as usually restricted, the anatomical details form the greater part of the work. The correctness of Gray's and Dorn's suggestions to unite *Streptaxis*, *Ennea* and *Streptostele* into a separate group has, I think, been satisfactorily proved, and the relation of these forms to *Testacella* will be pointed out further on. Of the *Clausiliidæ* I have given some notes regarding *Cl. Philippiana*, as the anatomy of no Indian *Clausilia* has yet been published. In the *Pupidæ* two interesting new species will be found described a *Pupa* and a *Hypselostoma*. In the *Helicidæ*, the propriety of the generic designations of *Plectopylis* and *Trachia* was found to be supported by the examination of the anatomy of the animals. Among the *Zonitidæ*, at last, I have in a similar way recorded the propriety of the generic names *Sesara* and *Sophina*, and there also will notes be found on the anatomy of *Macrochlamys*, *Rotula*, *Myerocystis* and a newly proposed genus *Conulema*.

Group. CYCLOSTOMACEA.

Fam. CYCLOPHORIDÆ.

The species of *Cyclophorus* (as restricted), known to occur in the neighbourhood of Moulmein : are (1) *C. Haughtoni*, Theobald, (from Moulmein itself), a species closely allied to Sowerby's *aquila*; (2) *C. affinis*, Theobald, (from Damotha), somewhat allied to Pfeiffer's *excellens*; and a third form is found at the Farm-caves, it has the angular periphery of *Haughtoni*, but a spotted shell like *affinis* or *Siamensis*. All the forms may be considered as varieties of one and the same species, but in order to ascertain whether Theobald's name *Haughtoni* is applicable to them, a close comparison of typical forms of several of the allied species from Siam and adjoining countries must be made. I will not enter now upon this question, as the three varieties noticed have lately been figured in the 'Conchologia Indica,' though by no means characteristically.

(4). *C. speciosus* (or perhaps rather *aurantiacus*) occurs at Zwagabin.

CYCLOPHORUS [MYXOSTOMA] CALYX, Bens.

Ann. and Mag. N. H., 2nd ser., XVII, p. 228,—Hanley and Theobald, Conch. Indica, pl. IV, fig. 4.

This species is found on all the limestone hills about Moulmein. The figure in the Conch. Indica is far from characteristic and entirely insufficient for the identification of the species. It is strange to find there again the mistake of the originally recorded locality "Akoutang" repeated, though Mr. W. T. Blonford had corrected it already twice.

The animal is identical in form with those of other CYCLOPHORIDÆ, only of smaller size; when full grown the body is black, with very long subulate tentacles, slightly thickened near the tips, the rostrum is long and deeply cleft in front, the foot rather elongated, posteriorly narrowly produced and pointed; eyes rather small, placed laterally at the base of the tentacles on barely perceptible bulgings. The sides of the foot and the tentacles are usually paler than the body, and young specimens are pale grey coloured throughout. The largest specimen found south of Moulmein measures: Diam. maj. 14; d. min. 12; alt. testæ 7·2, alt. ult. anf. cum perist. 5, diam. apert. int. 4 mm.

Cyclophorus [Myxostoma] Inglisianus, Stol., pl. vi, fig. 1.

Cycl. testa subdiscoidea, late umbilicata; anfractibus  $4\frac{1}{2}$ , primo depresso, albido, lævigato, ceteris teretibus, paululum in amplitudine accrescentibus, sordide lutescente albescentibus, strigis fuscis, supra retrorse angulatis, ad peripheriam rotundatam ult. anf. fascia castanea intersectis, notatis, epidermide pallida transversim rugulatim striata indutis; suturis profundis, simplicibus; apertura paulum descendente et obliqua, circulari, marginibus junctis, paululum in-crassatis, haud dilatatis, supra prope suturam leviter insinuat. Operculo corneo, tenui, circulari, anfractibus 7 extus paulo lamelliforme exstantibus composito, medio depressiusculo, intus polito, medio submammillato. Diam. maj. 9, d. min. 7·5, alt. totius testæ 5, alt. ult. anf. prope aperturam 3, diam. apert. 2·7 mm.

Animal plumbeo-cinereum, tentaculis longis, acutis, nigricantibus, pede pallidescente, angusto, postice acuto; rostro longo, nigricante, antice ad marginem modice lobato.

Pl. VI.

- Fig. 1. *Cyclophorus* [*Myxostoma*] *Inglisianus*, n. sp., p. 148.—1, natural size, 1*a*, 1*b*, 1*c* front, top and lower views, twice the natural size.
- Fig. 2. *Pterocyclus ater*, n. sp., p. 149.—2, 2*a*, 2*b*, front, top, and umbilical views, and 2*c*, operculum; all figures in natural size.
- Fig. 3. *Diplommatina carneola*, n. sp., p. 152.—front and side views.
- Fig. 4. *Dipl.* [*Palaina*] *crispata*, n. sp., p. 153,—ditto.
- Fig. 5. *Georissa liratula*, n. sp., p. 157, 5*e*, represents the internal side of the operculum.
- Fig. 6. *Georissa Blanfordiana*, n. sp., p. 158.
- Fig. 7-10. *Clausilia Philippiana*, Pfr., p. 174.—7, a series of teeth of the radula, the numbers indicate the distance of the teeth from the centre line; 8, the body with the different organs exposed; 9, the generative organs; 10, the jaw.

*ft.*—foot.

*t.*—eye-pedicle.

*oe.*—mouth.

*mr.*—retractile muscle of the body.

*a.*—anus.

*ab.*—part of mantle-edge.

*sg.*—salivary glands.

*mo.*—muscle of the oral parts.

*mt.*—right mantle side.

*li.*—liver.

*ut.*—uterus.

*cd.*—appendage of the receptaculum seminis.

*i.*—intestines.

*st.*—stomach.

*alg.*—albuminous gland.

*h.*—heart.

*k.*—kidney.

*l.*—lungs.

*p.*—penis.

*vd.*—vas deferens.

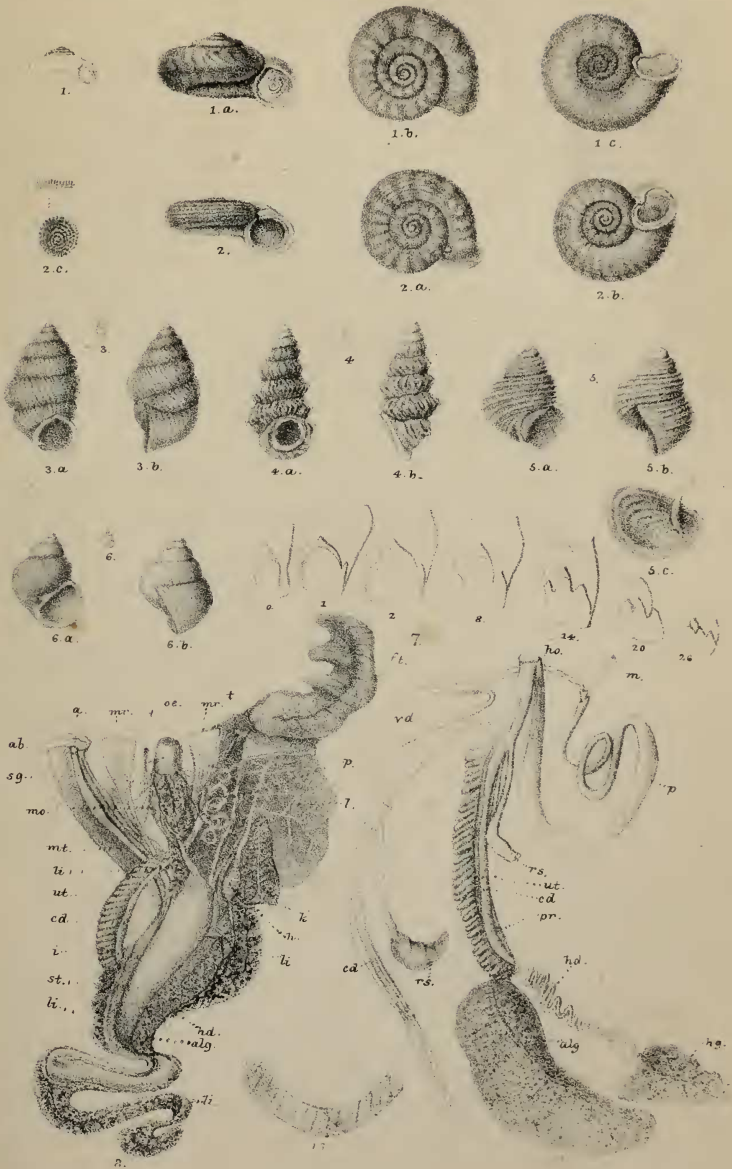
*m.*—retractile muscle.

*pr.*—prostate.

*hd.*—hermaphrodite duct.

*hg.*—hermaphrodite gland.

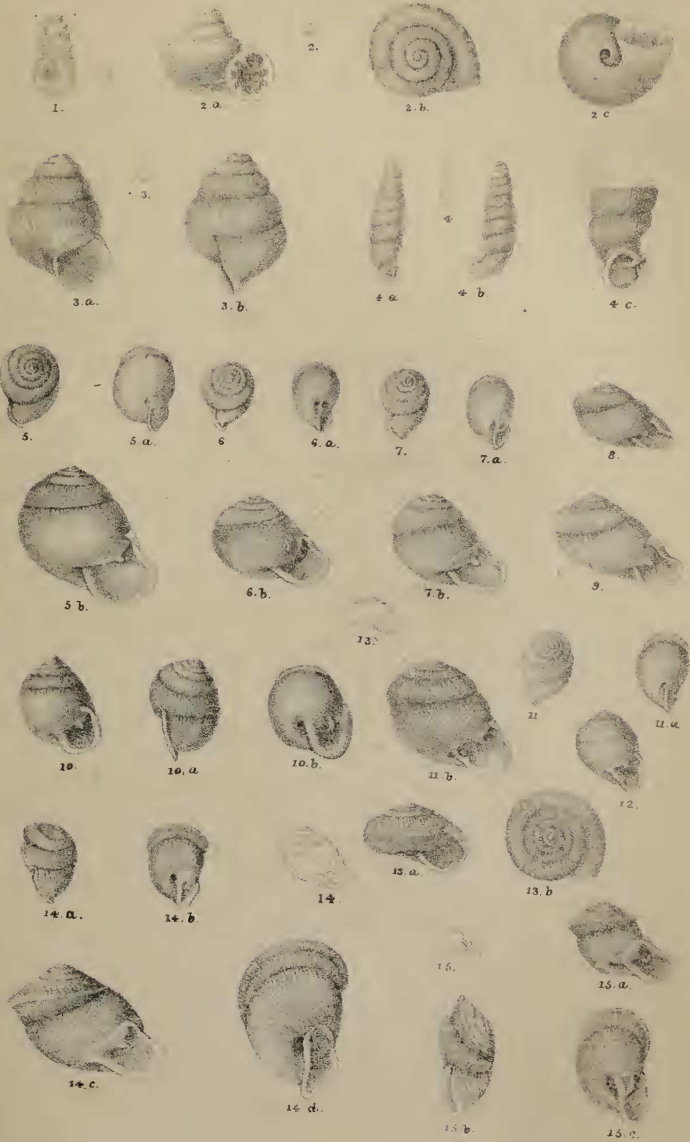
*ho.*—herm. opening.





Pl. VII.

- Fig. 1. *Hypselostoma tubiferum*, Bens., p. 173.—View of the animal seen from above.
- Fig. 2. *Hypselostoma Dayanum*, n. sp., p. 172.—front, top and lower views, enlarged.
- Fig. 3. *Pupa lignicola*, n. sp., p. 171.
- Fig. 4. *Ennea* [*Huttonella*] *cylindroidea*, n. sp., p. 171.
- Fig. 5, 6, 7. *Streptaxis Burmanicus*, Blf., p. 163. The front figures 5*b*, 6*b*, 7*b* are enlarged, the side and lower views of the shells are of natural size; 5 is a specimen from Tonghoo, very similar to the type which is from Arracan; 6 and 7 are from Rangoon.
- Figs. 8-9. *Streptaxis Blanfordianus*, Theob., p. 163, front views of two specimens, enlarged twice the natural size, 8 is from Arracan, 9 from Pegu.
- Fig. 10. *Streptaxis solidulus*, n. sp., p. 166.
- Fig. 11, 12, 13. *Strept. obtusus*, n. sp., p. 166.  
11 and 11*a* side and lower views, natural size; 11*b*, front view, twice the natural size; 12 natural size of a full grown specimen; 13, 13*a*, 13*b* young specimen.
- Fig. 14. *Strept. Sankeyanus*, Bens., p. 167. 14, 14*a* and 14*b* are of natural size, 14*c* and 14*d* enlarged.
- Fig. 15. *Strept. Hanleyanus*, n. sp., p. 168. The outline figure 15 shews the natural size of the specimen, the other figures are enlarged.



Pl. VIII.

Figs. 1 and 2 exhibit the anatomy of *Strept. obtusus*, (see p. 161); the letters have the following significations:

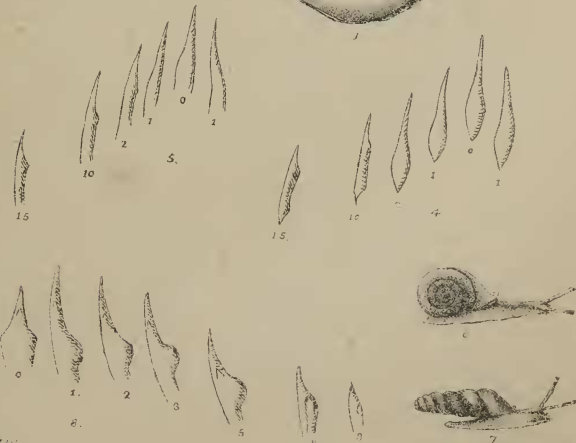
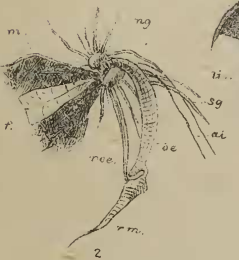
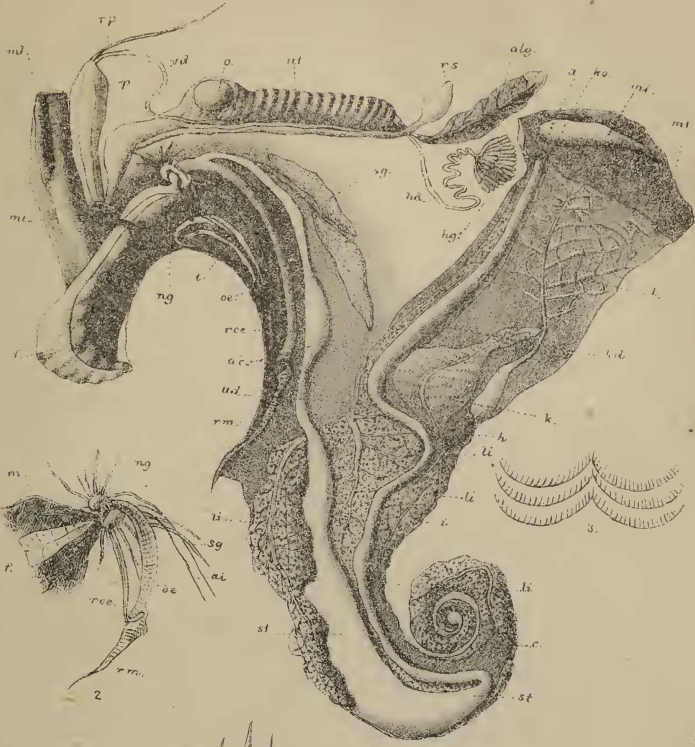
|                                   |                                                                              |
|-----------------------------------|------------------------------------------------------------------------------|
| <i>f.</i> —foot.                  | <i>h.</i> —heart.                                                            |
| <i>mt.</i> —mantle.               | <i>li.</i> —liver.                                                           |
| <i>ml.</i> —mantle lobes.         | <i>i.</i> —intestines.                                                       |
| <i>rp.</i> —penis retractor.      | <i>c</i> is the cavity where the generative organs were originally situated. |
| <i>p.</i> —penis.                 | <i>st.</i> —stomach.                                                         |
| <i>vd.</i> —vas deferens.         | <i>ng.</i> —nervous ring.                                                    |
| <i>o.</i> —ovum.                  | <i>t.</i> —eye-pedicles.                                                     |
| <i>ut.</i> —uterus.               | <i>roe.</i> —retractor of the mouth.                                         |
| <i>rs.</i> —receptaculum seminis. | <i>ac</i> —tube including the radula.                                        |
| <i>alg.</i> —albuminous gland.    | <i>oe.</i> (in figure 2)—ditto.                                              |
| <i>hd.</i> —hermaphrodite duct.   | <i>rm.</i> —chief retractor of the radula.                                   |
| <i>hg.</i> —hermaphrodite gland.  | <i>ad.</i> —anal albuminous gland.                                           |
| <i>a.</i> —anus.                  | <i>sg.</i> —salivary glands.                                                 |
| <i>ko.</i> —kidney opening.       |                                                                              |
| <i>l.</i> —lungs.                 |                                                                              |
| <i>kd.</i> —kidney duct.          |                                                                              |
| <i>k.</i> —kidney                 |                                                                              |

Fig. 3 shews the general arrangement of the teeth on the radula of *St. obtusus*.

Fig. 6. Side view of *St. Pfeifferianus* from the Nicobars; nat. size.

Fig. 7. Side view of *Ennea* [*Huttonella*] *bicolor*, from Calcutta; twice the natural size.

In figs. 4, 5 and 8 the numbers indicate the distance of the teeth from the centre line.



S. Sarsfieldi Zitt.

1-4. *Streptaxia obtusius*.  
5. " *Burmanicus*

6. *Streptaxia Pfeifferianus*.  
7-8. *Ennea* (*Bur. nolla*) *bicolor*

Colicula.

*Habitat* : Damotha, prope Moulmein ; raro.

This species resembles in its colouring *Pterocyclus Feddeni*, Blf., but is easily distinguished from it by its thinner and very gradually increasing whorls. The tubular form of these also readily separates the present species from *Cycl. calyx* which has the basal angulation always distinct. The only other allied species is *Pterocyclus cetra*, Benson, which differs by the well developed upper wing of the aperture. In *Inglisianus* the margin of the aperture is simply insinuated, and externally very slightly thickened.

I have associated with this interesting new form the name of J. W. Inglis, Esq., Executive Engineer at Moulmein, who has most kindly aided me in my conchological inquiries about that station.

*Pterocyclus ater*, Stol., pl. vi, fig. 2.

Pt. testa orbiculato planorbulari, latissime umbilicata ; apice vix exserto ; anfractibus quinis, depressiuscule teretibus, sutura profunda junctis, liris spiralibus tenuibus, plus minusve distincte setiferis, subdistantibus, ornatis, sub epidermide lividis, transversaliter fulguratim castaneo notatis, epidermide scabriuscula, transversim conferte striata, indutis ; ultimo anfractu ad aperturam sensim descendente ; apertura obliqua, circulari, peristomate duplici, interno paululum crassiculo, ad suturam emarginato, externo tenui, dilatato, supra in alam angustam, curvatam, atque ad anf. penultimum leviter affixam expanso, pone alam perforato. Diam. maj. 16·5, d. min. 13·5, alt. tot. testæ 7·2, axis 3·2, diam. diag. apert. cum perist. 6 mm.

Operculum orbiculare, supra lamellis spiralibus exstantibus, distincte denticulatis, compositum, infra lævigatum, volutionibus angustis spiralibus concentrice minute striatis.

Animal fere uniforme atrum, corpore supra, tentaculis ad terminationem et pede lateraliter ad marginem inferiorem paulo palidioribus ; forma ab ceteris speciebus ejusdem generis haud distincta.

*Hab.* Kuengan, ad flumen Ataran, prope Moulmein ; cepit Theobald.

This is a very interesting planorboid and spirally lirated species. The outer lip is at the suture produced in a narrow obtuse wing,

curved towards and loosely attached to the previous whorl, leaving a rounded circular foramen behind it. The whorls of the operculum are above peculiarly dentate.

RHIOSTOMA HAUGHTONI, Bens.

An. and Mag. Nat. Hist, 3rd ser., V, p. 96.—Reeve Iconica, vol. XIV *Pterocyclos*, pl. V, fig. 30.—Hanley and Theobald, Conch. Ind., pl. V, fig. 10.

Young specimens have no trace of the upper notch at the outer lip and are generically undistinguishable from the planorboid *Cyclophori*, like the Ceylon *C. annulatus*, Trosch., or the Nilgherry *C. ravidus*, Bens. Only in full grown specimens, the last whorl at the aperture becomes detached from the previous whorl. The operculum is first thin, flattened outside and slightly concave inside; gradually the shape becomes convex outside, as the whorls increase in number, and at the same time the internal concavity enlarges.

The animal is quite similar to that of *Pterocycelus*: it is dirty white, with darker minute spots on the back, translucent pinkish between the tentacles and partially on the front side of the foot; tentacles of moderate length, blackish, paler at the tips which are hardly swollen; the edge of the mantle fits very closely to the shell, it is somewhat thickened, and has a small slit corresponding to the upper tube-like incision on the outer lip; the sides of the slit are very extensible and secrete the tube. Young specimens generally possess a distinct pinkish white tint on the entire body.

*Hab.* At Damotha, (N. E. of Moulmein), on limestone rocks; found under decaying leaves and humus. The animal appears to be more nocturnal in its habits, than the true *Pterocyceli*, and is very shy.

Fam. PUPINIDÆ.

POLLICARIA GRAVIDA, (Bens.).

*Hybocystis graviora*, Bens., vide Pfeiff., Mon. Pneumonop. viv., suppl. 2nd, p. 56.—Hanley and Theob., Conch. Indica, pl. 7, fig. 1,\* *Megal. gravidum*, Bens.

The peculiarity of this genus rests, I believe, chiefly in the remarkably flattened growth of the last and penultimate whorls of

\* This figure is somewhat incomplete; it does not shew the short open canal above the posterior angle of the mouth. The position of the operculum in the aperture is not correct. It should rest on the internal swelling close to the margin of the outer lip of the aperture.

the shell, a character specially pointed out by Gould in his brief description, and there can be, therefore, no distinct objection as to the priority of Gould's generic appellation. In my forthcoming "Monograph of the Indian CYCLOSTOMACEA," I will give illustrations of the very peculiar progress in the growth of the shell of this species.

Animal resembling a gigantic *Diplommatina*, of a pale fleshy colour, transparent pink at the rostrum. The foot is short and stout, below at the middle of the sole entire; the rostrum short, thick, deeply cleft at the front end; the tentacles are of moderate length, attenuated towards, but somewhat obtuse at, the tip itself, of a pale grey colour; the eyes are small and placed laterally at their bases on minute bulgings. The sexes are, as usually, distinct, and the copulative organ of the male is situated laterally, somewhat in front of and almost immediately below the right eye.

*Habitat.* Common on the limestone hills at the "Farm-caves," and at Damotha. I have not met with a single specimen on the hills south of Moulmein.

#### RAPHAULUS CHRYSALIS, Pfr.

I have only obtained a single live specimen at the Farm-caves, near Moulmein. The animal was pale greyish white with a slight fleshy tinge; tentacles rather long and pink; rostrum stout, the red oral parts shining through at its base, its front edge is slightly lobed. There is a regular canal leading from the pulmonary cavity backwards, then piercing the mantle and entering the tube which runs again forward on the internal side of the last whorl below the suture, until it terminates in the external apertural tube. The form of this tube is different from that of *Pupina* or *Alycæus*, but it is very much the same as in *Streptaulus*. (Comp. Blanford in A. and Mag. N. H., 3rd ser., xii, p. 55).

#### PUPINA ARTATA, Bens.

Hanley and Theobald, *Conch. Indica*, pl. vii, 5.

This species is common on all the limestone hills about Moulmein. The animal is whitish or pale grey, sometimes darker at the sides of the foot which is moderately elongated and

posteriorly pointed. Tentacles blackish, thin and subulate in young, considerably thicker in older specimens; eyes rather large, black, placed laterally and somewhat posteriorly on distinct bulgings at the base of the tentacles; rostrum rather short, slightly cleft in front, the buccal parts red, shining through; mantle with a small slit on each side corresponding to the incision in the shell, the lower edges of the slits are slightly thickened and rather distinct, the upper almost perfectly continuous with the outer, slightly thickened, edge of the mantle.

The horny, moderately thickened, operculum closes the aperture perfectly; it has a thin fringe at its edge all round and is externally slightly impressed in the centre. The live shell is covered with a thin layer of slippery glaze. Young shells are regularly coiled, like a little conoid *Helix*, and quite transparent. There is no difference in the coloration of the sexes.

*Fam. DIPLOMMATINIDÆ.*

*Sub-fam. DIPLOMMATININÆ.*

*Diplommatina carneola*, Stol., pl. vi, fig. 3.

*Diplommatina* testa ovato elongata, turrata, vix rimata, carnea, seu carneo-luteola; anfractibus 7, valde convexis, suturis profundis junctis, primis duobus lævigatis, luteis, ceteris costulis obliquis, modice distantibus, ornatis, penultimo maxime inflato, ad terminationem valde constricto, ultimo minore, ad basin rotundato; apertura rotundata, marginibus paulo dilatatis et incrassatis, ad anfractum penultimum conspicuiter ascendentes, intus lævigatis: labio adnato, paulo expanso, labro duplici, extus prope marginem costa tenui et acuta instructo, collumella fere recta, infra dente unico instructa, ad basin vix angulata. Diam. anf. penult. 1·2; alt. tot. testæ 2·6, apert. alt. 0·8, ejusdem diam. 0·8 m.m.

Animal carneo-luteolum, tentaculis, rostro ad terminationem, interdumque dorso supero, plus minusve distincte atratis; oculis magnis in latere basali tentaculorum sitis, atris, pede angusto, postice acuminato; operculum corneum, tenuissimum, concentrice multi-spiratum.

*Hab.* Damothen, prope Moulmein.

This species is somewhat allied to *D. Puppensis*, Blf. (Journ.



Asiat. Soc. XXXVII, pt. II, pl. iv, fig 2), differing from it by its constant smaller size, more tumid or convex, and more widely costulated whorls, and by the aperture being at the columellar base rounded or nearly so, instead of deeply angular and canaliculate, as it always appears to be in *Puppensis*.

The present species was found to be very common on the perpendicular limestone cliffs at Damotha, especially in localities where a little water trickled down the rock. The animals seemed to feed on the minute algæ which were growing in the locality.

*Diplommatina* [*Palaina*] *crispata*, Stol., pl. vi, fig. 4.

*Diplommatina* [*Pal.*] *testa conoidea, medio latissima, sordide albida, anfractibus 7, primis duobus (rare 1½) mammillatis, lævigatis convexis, sequente convexiusculo, confertim lamellose striato, ceteris medio angulatis, crasse lamellatis, lamellis crebris, inæqualibus, tenuibus, undulatis et crispatis, ad peripheriam angulosam spiniforme productis, latere interiore excavatis; anf. penultimo haud distincte constricto; ultimo angustiore, basi convexiusculo; apertura perobliqua, circulari, extra dilatata, intus continua, lævi, supra leviter adnata, ad latus columellare incrassata et infra dente pliciforme, vix distinguendo, instructa, margine interno acuto, undique libero; peristomate externo tenui, lamelliforme undulato et late expanso. Alt. testæ 2·5; diam. anf. penult. (spinis incl.) 1·5; diam. apert. int. 0·8, d. ap. cum perist. 1· m.m.*

Animal albidum, tentaculis cinereo atratis; operculum corneum.

*Habitat.* Damotha, prope Moulmein; rarissime cum precedente.

This is the first species from British India referable to the subgenus *Palaina* of Semper (vide Journ. de Conch. 1863, p. 291, and 1866, p. 348), although, if the subgenus should be retained, it cannot include all the species referred to it by its author. The various subdivisions of *Diplommatina* appear to me to have been suggested more with a view to geographical distribution, than to the necessity of conchological grouping. Whether the shells are coiled to the right or left constitutes no generic difference in *Diplommatina*, as it does not in cases of *Helix* or *Bulimus* &c., even as regards specific distinction.

The peculiar characteristic of *Diplommatina* lies in the very marked constriction of the penultimate whorl, (compare Journ.

Asiat. Soc. Bengal, vol. XXXIX, pt. II, pl. ii, fig. 3-5), in the short internal parietal rib just at the beginning of the last whorl, and in the twisted columella which terminates in the aperture with a tooth, sometimes placed so far internally as to be hardly visible, but very rarely becoming nearly obsolete. In addition to these characters the typical species have the whorls either partially or wholly transversally costulate or striated, and the shell itself is of a moderately solid structure.

Semper instituted the genus *Palaina* for a number of Philippine species, some of which, like *P. polymorpha*, *P. strigata*, and others (see J. de Conch. 1866, pl. ii and x,) do not in any way differ from typical Indian *Diplommatinæ*. In other species, noted by Semper, as for instance in *P. pupa*, *patula*, *Wilsoni*, &c., the general character of the shell is the same, the constriction more or less distinctly marked, but the columellar tooth is not visible. The same can be observed in some allied Himalayan forms, as *D. Huttoni* or *costulata*, though looking into the aperture obliquely, the abrupt termination of the columella may, for instance in the last-named species, be readily seen. I do not think it, therefore, improbable that the terminal twist and truncature of the columella also exists in these Pelew, or Philippine, *Palainæ*, in which case there would be no reason whatever to separate them generically, or subgenerically, from *Diplommatina*.

Other species, again, like *Pal. pyramis*, *alata* and *lamellata* of Semper (l. cit.) are distinguished by a round, almost tubular aperture, with a free sharp continuous margin, being internally conspicuously thickened and obliquely placed towards the axis of the shell; the whorls are ornamented with transverse lamellar ribs, mostly projecting at the middle, the penultimate whorl is not distinctly constricted, and the columellar tooth is in some visible, in others not, though I have little doubt but that in all the columella is twisted and in the interior of the aperture truncated. For this group the name *Palaina* may be retained, but *only* as a subgenus of *Diplommatina*; for on comparing species like Blandford's *D. exilis* from Ava, it will be readily seen how closely connected all these forms are.

For Mousson's *Pupa problematica*, from the island Upolu, Semper proposed the subgeneric name *Moussonia*, changing (why?) the specific into *typica* (comp. J. de Conch., 1865, p. 296, and 1866, pl.

x, fig. 9). This species has the general form, usual costulation of the whorls, and the columellar tooth of *Diplommatina*, but no apparent constriction at the termination of the penultimate whorl. Only if this last character should prove constant, could the subgeneric name be retained, though this seems to be rather doubtful. Mousson recently (J. de Conch. 1870, p. 188, pl. viii, fig. 9), described from one of the Viti islands a *M. fuscula*. It is about as much elongated as the type species, smooth, but the constriction on the penultimate whorl is distinctly perceptible; therefore this species does not differ in any essential point from *Diplommatina*.

In 1864, E. v. Martens suggested the name *Diancta* for a sinistrorse species from Ternate, distinguished by a very marked constriction of the penultimate whorl, hence the specific name *D. constricta* (vide Moll. der Preuss. Exp. nach Ost-Asien, p. 164). The same author states (ibidem) that *Diplommatina* has no columellar fold, which is evidently a mistake, for its existence had been recorded in many of the Indian species then known, but no figures were published. *D. constricta* does not possess a columellar fold or tooth; it is probably situated far internally, but the constriction evidently indicates that the columella must be strongly twisted. Besides Adam's *Diplommatina Martensi* there have been (J. de Conch. 1870, p. 180 et seq., pl. viii,) several species lately described by Mousson under the subgeneric name *Diancta*. They are all sinistrorse, like the Indian *D. gibbosa*, Blf., but in no other respect generically, or even subgenerically, different from *Diplommatina*.

In connection with these various forms of *Diplommatina* I must mention H. and A. Adams' genus *Paxillus*, proposed for a species from Singapore, *P. adversus*. The columellar fold is strong and the constriction distinct in this species, as well as in Martens' *P. rubicundus*. I do not see any characters by which these shells could be separated from *Diplommatina*. Gould's two Chinese species referred to *Paxillus* are too insufficiently characterized to admit of a correct opinion being formed regarding them.

In conclusion I have to allude to the subgenera *Arinia*, H. and A. Adams and *Nicida*, Blanford. Of the former Sowerby's *Cyclost. minus*, from the Philippines, has been considered as the type, and another allied species, *A. scalatella*, was described by Dohrn from

Luzon, (vide Journ. de Conch. for 1866, p. 352). *Arinia* are small shells, allied to *Diplommatinæ*, but of a thin structure, with smooth, or nearly smooth, surface, without a distinct constriction on the penultimate whorl, and without a fold on the columella.

Mr. W. T. Blanford (Journ. Asiat. Soc. xxxvii, 1868, p. 82, and also Journ. de Conch. for 1868) proposed the name *Nicida* for six species from South India. Three of these *N. Pulneyana*, *liricineta*, and *Kingiana*, do not externally appear to offer any generic, or sub-generic, distinction from *Arinia*. In all these the position of the small operculum when retracted is exactly the same as in *Diplommatina*, and the same internal parietal plait exists at the beginning of the penultimate whorl; the columella is twisted, with a fold, but the latter becomes obsolete at the aperture, not terminating in a tooth. Mr. Blanford, therefore, very properly stated that *Nicida* must only be considered as a subdivision of *Diplommatina*, on which point there can be no doubt. I have seen the animal of *Nic. liricineta*, and it is exactly like that of *Diplommatina*. It does not appear to me at all improbable that *Arinia* and *Nicida* will have to be united into a single subgenus; Sowerby's figure of *minus* is rather in favour of this view, but I have not that species for comparison and in order to settle the relation which is supposed to exist between *Arinia* and *Nicida*, it is absolutely necessary that the internal structure of the ultimate and penultimate whorls of the two species of *Arinia* be compared with these same parts of the shell of *Nicida*. If a twisted columella and a parietal rib do not exist in *Arinia*, the genus will have probably to be placed near *Callia* and *Streptaulus* in the PUPINIDÆ.

With regard to Mr. Blanford's three other species of *Nicida*: *N. nitidula* shews a very slight constriction of the penultimate whorl, and *Nilgirica* (the type) and *Fairkanki* have it very distinctly developed externally. They, therefore, only differ from *Diplommatina* by the thin structure of their shells, and by the want of transverse costulation on the whorls.

To sum up—we have in the *Diplommatina* group of PNEUMONOPOMA, 1st, the genus *Diplommatina*, with the subgenera (a) *Palaina* (of the type of *P. pyramis*, Semp.), (b) *Moussonia*, (with the type *Mouss. problematica* (alias *typica*), the subgenus being only admissible,

if the penultimate whorl has no trace of a constriction,—(c), *Diancta* (with the only species *D. constricta*), only admissible if there be no tooth or truncate columella in the aperture; (d), *Arinia* (type *A. minus*) and (e), *Nicida*, Blanf. (type *N. Nilgirica*), the latter admissible as distinct from the former, if *Arinia* has no internal parietal plait and the columella not twisted. Mousson's numerous species of *Diancta* are certainly nothing but *Diplommatinæ*, and I also very much doubt whether there is sufficient reason for retaining *Paxillus* as distinct from *Diplommatina*.

2nd, *Clostophis* of Benson. I have not been successful in the discovery of a specimen at the Farm-caves, or in any other locality about Moulmein.

3rd *Opisthostoma*, Blanf., is a good distinct genus of the DIPLOMMATINIDÆ.

Sub-fam. ALYCÆINÆ.

The only interesting species, which I found on the limestone hills south of Moulmein, is the very rare *Alycæus Richthofeni*, Blf., (Contrib. Indian Malacol., No. 4, Journ. A. B. for 1863, vol. xxxii, p. 324). Only a single specimen occurred. Blanford's description is excellent.

Fam. HELICINIDÆ.

Sub-fam. HYDROCENINÆ.

*Georissa*\* *liratula*, Stol., pl. vi, fig. 5.

Geo. testa globoso-conica, solida, imperforata, carneo-luteola; anfractibus 3 - 3½, convexis, sutura profunda simplici junctis, primo apicem subobtusum formante mammillato, lævigato, luteolo vel rubescente, cæteris supra (infra suturam) paululum depressiusculis, spiraliter liratis, liris acutis, simplicibus, fere æquidistantibus, in anf. penultimo 6-7, in ultimo 9-10, basi convexa, centraliter minute multistriata; apertura semilunari, altitudine fere spiram æquante, haud dilatata; labro simplici, curvato, intus striato, labio incrassato, albedo, adnato, intus rectiusculo, lævi. Operculum testaceum, tenue, diaphanum, latiuscule semilunare, (nucleo excentrico),

\* I prefer keeping *Georissa* as distinct from *Hydrocena* in the hope of examining the animals of both the typical species at an early date. For the relation of the two genera vide W. Blanford in Ann. Mag. Nat. Hist. for November, 1870.

striis incrementi rugulosis vestitum, intus ad nucleum apendice tenui, longo, lateraliter sub marginem columellarem projiciente, instructum.

Diam. maj. 1·8, d. min. 1·5, alt. testæ 2·2, alt. ult. anf. ad aperturam fere 1·0, lat. apert. 0·7 m.m.

Animal sordide rubescente albidum, rostro lato, nigricante, tentaculis brevissimis, vix projicientibus, latis, medio fere confluentibus, oculos parvos supra, ad basin et paulo lateraliter sitos, gerentibus; pede breve, subovato, pallido.

*Habitat.* Damothes, prope Moulmein, frequens.

I found this species common on the limestone hill near Damothes together with *Diplommatina carneola*, and others. It is mostly allied to the Khasi hill species *G. sarrita*, Bens., but is more globose and a little more numerous spirally ribbed. It also appears to be closely allied to Benson's *G. Rawesiana* (Ann. and Mag. N. H., 3rd ser., vol. vi, p. 193), but on comparing the description of the former it seems unjustifiable to identify both. Benson says: "conferentim spiraliter striata;" this could hardly apply to the rather strong and by no means very numerous spiral ribs of *liratula*. Farther Benson says "apice obtuso;" he could hardly have overlooked the mamillate form of the first smooth whorl of *liratula*, forming the apex. I never observed in the last species, four complete whorls which *Rawesiana* is said to possess.

The measurements of both very nearly agree, but *Rawesiana* would seem to be a more slender shell. Benson gives the height of his shell as 2, and the diam. (largest of course) as 1·5 m.m.; in specimens of *liratula* with a height of 2 m.m. the greatest diam. never appears to be below 1·6, generally a little more. There is also no perceptible impression at the umbilical region in *liratula*. In other respects both species appear fairly to agree.

*Georissa Blanfordiana*, Stol.; pl. vi, fig. 6.

Geo. testa globoso conoidea, imperforata, moderate solidula, luteola, apice rubescente, mamillato, lævissimo; anfractibus  $3\frac{1}{2}$ , convexiusculis, transversaliter striis incrementi minutis tectis, sublævigatis; ultimo ad peripheriam rotundato, in altitudine spiram subæquante; apertura late semilunari: labro, uniforme cur-

vato, postice (vel supra) angulata, labio incrassato, levissime arcuato, supra paululum dilatato, infra angustiore. Diam. maj. 1·2, d. min. 1·0, alt. testæ 1·8; alt. ult. anf. ad apert. 0·8; lat. apert. obliq. 0·5. Operculum animalque non vidi.

*Hab.* "Farm caves" prope Moulmein.

A single specimen of this species was found in the same locality from which *G. Rawsiana*, Bens., was described. It differs from all known *Georissæ* by the absence of spiral striation. The form of the shell is very much the same as that of the previous species.

*Group.* **HELICACEA.**

*Fam.* **STREPTAXIDÆ.**

Dohrn in 1866, (Maloco-zoologische Blätter, vol. xiii, p. 129), proposed to unite *Streptaxis*, *Ennea* and *Streptostele* into a separate group, for which he suggested the name STREPTOCIONIDÆ. There does not appear to be any reason, why we should deviate from the generally introduced custom in selecting the family name from that generic one which includes the most typical forms of the group, and this genus is in the present case *Streptaxis*. The family has already been pointed out by Dr. J. E. Gray, in 1860, (Ann. and Mag. N. H., vi, p. 268), under the name STREPTAXIDÆ.

The three above noticed genera, (each of which includes several characteristic sections), have the following characters common: a thin hyaline or a thicker alabastrine shell with very thin, deciduous epidermis, an expanded lip of the aperture, producing in the course of growth a transverse costulation of the whorls, the last of which somewhat deviates from the axis of the spire; the columella is always thickened and often toothed, or provided with a projecting lamella.

Dohrn appropriately pointed out the striking relations of the shells of the three genera by quoting the following parallelism: "*Streptaxis* is helicoid, *Ennea* pupoid, and *Streptostele* achatinoid."

The same author does not describe the animal of *Streptostele* and its anatomy, probably because they are very similar to those of *Streptaxis* and *Ennea*. I have examined several species of the latter two genera, and they all agree in the usual bright, yellow or red colouring, extending over the greater part of the body, or being

restricted to the head; the anterior part of the body is always long, extensible, and the posterior short; the peduncles are long, subcylindrical, but the tentacles much shorter, exactly as in the HELICIDÆ. The mantle is thickened, generally with a short lobe, or a thickening, on each side of the pulmonary orifice. The internal organisation closely corresponds with that of the HELICIDÆ, except that the œsophagus is below produced in a tough cylindrical tube, which contains the radula in the form of a narrowly curved sheath; the tube is attached by a special strong muscle to the retractor of the body (see pl. viii, fig. 2). The teeth of the radula are very simple, subconical, pointed, from 40-60 in each transverse row. A special jaw is, as far as observations have been made, not developed.

All the species which I have observed were found under stones, or trees, and old wood, or under dead leaves and other organic substances. Whether, or not, the species are carnivorous, as stated by Gray, I have not been able to verify. They are oviparous, like the *Bulimi*.

Considering the form of the teeth, the STREPTAXIDÆ are closely allied to the TESTACELLIDÆ, next to which they are also classed by Gray. Both families agree in the great length of the anterior part of the body and in the more or less secluded habitat. But upon inspection of the anatomy of *Testacella*, as given by Cuvier, I fail to notice the peculiarity of the long cylindrical tube containing the radula; this appears to be a good reason for accepting Gray's classification of *Testacella*, with *Daudebardia*, in a separate family. A third group containing some of the anatomical characters of *Streptaxis* is represented by *Glandina*, but *Cylindrella* and its allies belong to the HELICIDÆ, as lately shewn by Crosse and Fischer.

#### STREPTAXIS, Gray.

This genus characterizes in India the Malayan fauna, most of the species being found either on the higher hills of South India, or in North-Eastern Bengal, and from thence southwards through the whole of Burma and the Tenasserim provinces. The greater number of the species, occurring in this extensive zoological province, are distinguished by a single parietal plait in the aperture, only



few possess also small teeth on the outer and columellar lips. The same group of *Streptaxis*, with a single parietal fold, also extends to the islands of the Indian Archipelago and to China on the one, Mauritius and the Seychelles on the other hand.

The animals of *Streptaxis* are characterized, as already noticed, by the great length of the anterior part of the body,\* while the posterior part, or the foot, is very short and often barely protrudes beyond the apex of the shell, when the animal creeps about. The sole of the foot is usually grooved along the middle, but not distinctly.

I am not aware that the anatomy of any of the Indo-Malayan species of *Streptaxis* has been published, and I give, therefore, a short account of that of *St. obtusus* and *Burmanicus*.

*St. obtusus.* An inspection of fig. 1, on pl. viii, will shew that in the main points the organs are quite similarly arranged as in the HELICIDÆ, only with some modifications adapted to the shape of the animal. The mantle is above, at the pulmonary orifice, considerably produced, receding ventrally, but remaining entire. On the inner side it has near the margin an elongated, thickened appendage on each side of the pulmonary opening. The pulmonary cavity itself is very long, but the lungs narrow, the reticulations being very fine and mostly simple. The digestive system differs from all HELICIDÆ which I have examined, by the peculiar development of the buccal parts. The mouth is wide, and immediately behind it, where it makes an angle, lies the nervous ring, consisting above of two larger, and below of two smaller ganglions, the latter being connected by a narrower bridge than the former. Immediately behind the nervous ring, the buccal parts are produced into a cylindrical muscular tube which extends in a slight curve up to the end of the chief retractor muscle of the body, where it is firmly attached by a special, thick, muscle. A few separated threads connect the mouth direct with the anterior end of the retractor. The ring-muscles forming the outer layer of the tube are almost horny, or at least very tough. The longitudinal muscles forming the internal layer are much softer, but considerably thicker.

\* See pl. viii, fig. 6. *Streptaxis Pfeifferianus* from *Camorta*, one of the Nicobar islands. Body bright yellow, pedicels coral red, this colour tinging the back. Lives under dead leaves in forests.

The radula is very long, but the teeth are generally only on its anterior portion well developed. The alimentary canal branches off near the upper anterior end of the sheath of the radula; a short distance from its origin it is somewhat widened and then passes into the stomach, which has no appendages. The intestines make only one simple turn. The rectum is accompanied by a narrow albuminous gland, which has its duct at the lower end of the rectum. Salivary glands moderately broadly linguiform, thin, each attached by a long thread behind the issue of the œsophagus from the sheath. Kidney large, of a pale livid colour, subquadrangular, lanceolately prolonged on the side of the heart; the duct is on the right side and accompanies the rectum in its entire length, lying on the left side of it.

The retractile muscle of the body is not very long, but strong. Its terminal end is almost quite horny; it is, so to say, the seat in which all muscular action appears to be concentrated. I have already noticed that the mouth is attached by a few direct muscles to the retractor; the same is also the case with the penis retractor and the muscles of the generative organs. The eye-pedicles also have their origin there, joining the retractor at about half its length.

The generative organs are of a simple form. The oviduct is thickened near the end; the uterus, as usually, foliated, terminating with an elongated albuminous gland of moderate size; the hermaphrodite duct very much twisted and long; the hermaphrodite gland small, composed of a cluster of tubes. The receptaculum seminis is small, its peduncle as long as the uterus to which it is grown to almost in its entire length. Vas deferens very short, without any appendages. Penis short, very muscular, attached by a very long thin muscle, almost horny towards the end. In two specimens, (one of *St. obtusus* and the other of *Burmanicus*), I found the anterior end of the uterus somewhat enlarged; it contained a few large eggs. They were perfectly spherical, but as the specimens had been in spirit for a long time, nothing was discernible in the solidified yolk-mass. Each egg was enclosed in a white calcareous skin, which was still quite flexible, but no doubt turns into a solid calcareous shell after it has been deposited. The *Streptaxes*, therefore, appear to be oviparous, like the *Bulimi*, *Achatinæ* and other HELICIDÆ.

I have not been able to find a distinct jaw, either in *obtusus*, *Burmanicus*, *Pfeifferianus* or *Andamanicus*. The upper lip is only slightly thickened on the upper side, where the jaw should be situated.

The radula is long, narrow, the lateral margin on either side curved upward; it is composed of numerous, very angular series of simple, almost straight, sharply pointed, teeth, provided below with a small projection. They are very different from those of the *HELICIDÆ*, but, as already noticed, strongly resemble those of *Testacella*. There appear to be from 40-50 teeth in each row.

The anatomy of *St. Burmanicus* is very similar to that of *obtusus*. A few unimportant differences I shall notice further on. I have also examined *St. Andamanicus* and *Pfeifferianus*, and found their anatomical characters quite similar to those of *obtusus*. The form of the teeth appears to be particularly characteristic.

1. *STREPTAXIS BURMANICUS*, Blf., pl. vii, figs. 5, 6, 7.

1865, J. A. S. B. vol. XXIV, pl. ii, p. 81 and p. 95.—Hanley and Theobald, Conch. Indica, pl. viii, fig. 10, (non fig. 5).

2. *STREPTAXIS BLANFORDIANUS*, Theob., pl. vii, figs. 8, 9.

J. A. S. B., vol. xxiv, p. 245, et Conch. Ind., pl. viii, fig. 5, (non fig. 10).

These two species are closely allied to each other. Blanford's description must stand as that of true *Burmanicus*, of which fig. 5 pl. vii, represents a characteristic specimen. It is a globosely inflated shell with a subconic, slightly oblique spire, the antepenultimate whorl laterally barely projecting, in a front view, beyond the periphery of the last whorl. In Mr. Theobald's description of *Burmanicus* characters are noticed which only apply to his *Blanfordianus*; the description must have been taken from specimens of both the species. Specimens, agreeing in shape and size with typical forms of *Burmanicus* from Arracan, also occur at Tonghoo, where they were collected by Mr. Theobald, (see pl. vii, fig. 5). On the hill of the great Pagoda at Rangoon, I found a smaller variety. Two forms of this latter are represented in figs. 5 and 6. The aperture is slightly more produced and narrower, but the characteristic form of the whorls and their volution are retained.

The animal has the anterior part of the body, as usually, very

long and the foot posteriorly very short and depressed, below with a median, slight, groove. The general colour of the body is yellowish, with small brownish warts and some indistinct striæ above, towards the head vermilion red; pedicles vermilion, long, with the eyes on rather large bulgings; tentacles short and paler red. The lips of the mouth possess above small protuberances which are used as tasters when the animal moves about; foot narrow, white; edge of mantle very pale yellowish.

The upper portion of the mantle has internally on the left side of the pulmonary opening a double appendage: externally a small rim and next below it a longer linguiform appendage. On the other side of the pulmonary orifice there is a similar appendage, only a little shorter than the last. Both are tough, solid and generally of a brownish colour. Besides this there is a small appendage at the umbilical region. The general organisation is the same as in *obtusus*, only the receptaculum seminis is thinner and smaller, the vas deferens longer; the salivary glands are larger and broader, the albuminous gland is elongately and somewhat irregularly ovate, it lies at the beginning of the rectum and does not extend along it; the kidney is elongately quadrangular, slightly produced on the anterior end of the side of the heart; it is of a dark green colour, composed of large, (in spirit specimens) quite opaque, cells.

The teeth are very similar to those of *obtusus*, perhaps a little stouter, (see pl. viii, fig. 5).

In the "Conch. Indica" the two species have been exactly transposed. Fig. 5, which is cited as *Burmanicus* is a typical form of *Blanfordianus*, on the contrary, fig. 10 which is stated to be the last named species appears to be taken from a Rangoon variety of *Burmanicus*. Such mistakes in a work specially devoted to illustrations of Indian shells are really deplorable!

*St. Blanfordianus* is distinguished from *Burmanicus* by a more depressed and elongated form, the last whorl being more obliquely extended, so as to allow the previous one considerably to project with its rounded edge beyond the periphery of the last whorl. The spire is in the former species generally slightly prominent, but the costulation of the whorls more crowded and intersected by mere striæ, except

towards the aperture; the size is also smaller. Mr. Theobald's typical specimen had beside the parietal fold a small tooth about the middle of the inner side of the outer lip, as shewn in fig. 8; this specimen perfectly equals in size the type. However, the tooth on the outer lip, upon which Mr. Theobald strongly relied as a distinctive character, is not constant. I found a specimen exactly similar to the type on the Rangoon Pagoda, but without an outer tooth; and quite similar specimens have also been collected by Mr. Fedden in the Shan States. The same, but slightly larger, variety occurs in Pegu; this is represented in fig. 9, pl. vii. Its only difference consists in size, approaching that of *Burmanicus*.

Mr. Blanford (l. c. p. 95,) considered the form, called by Theobald *Blanfordianus*, as identical with Benson's *Andamanicus*, and both certainly are most closely allied to each other. I possess numerous specimens of the last species, and most of them seem, as compared with *Blanfordianus*, a little more longitudinally stretched; all have the spire peculiarly depressed,\* the whorls being separated by rather deep sutures, and are somewhat convex above; the costulation also appears to be a little coarser and the umbilicus more spacious; but all these distinctions are only relative, and it is very difficult to appreciate them without a large number of specimens for comparison.

The animal of *Blanfordianus* is very similar to that of *Burmanicus*, except that the yellow and red colours are paler. The comparative measurements† of the two species are:

|                       | <i>Burmanicus</i> . |                    | <i>Blanfordianus</i> . |                 |           |
|-----------------------|---------------------|--------------------|------------------------|-----------------|-----------|
|                       | Typical.            | Var.               | Typical.               | Var.            | Var. mag. |
| Diam. maj., . . . . . | 10·5                | 8·8-8·6            | 7·3                    | 7·6             | 9· m.m.   |
| „ minor, . . . . .    | 7·6                 | 6·5-5·8            | 5·                     | 5·              | 6·2 m.    |
| Altitudo, . . . . .   | 9·                  | 6·2-6·6            | 5·                     | 5·4             | 7· ,,     |
|                       | ⏟                   |                    | ⏟                      |                 | ⏟         |
|                       | Arracan.            | Rangoon<br>Pagoda. | Pegu.                  | Shan<br>States. | Pegu.     |

\* Fig. 6, pl. viii, given in the "Conch. Indica," is in this respect not a characteristic one.

† In taking the height of *Streptaxis* the shell is placed in such a position that the axis of the upper regularly coiled whorls stands vertical, the two last whorls always somewhat deviate from the direction of this axis.

**Streptaxis solidulus**, Stol., pl. vii, fig. 10.

St. testa ovato-conoidea, moderate umbilicata, albida, solida; anfractibus 7, primis 5 regularibus, spiram exsertam, late conicam, formantibus, duobus ultimis modice deviantibus, omnibus planiusculis, seu subconvexis, sutura impressa simplici junctis, transversim conferte costulatis: costulis flexuosis, in ultimo anfractu distantioribus, basi obsoletis; apertura late subquadrangulari: labio tenui prope medium uniplicato, labro intus levi, undique planate reflexiusculo; diam. maj. 12, d. min. 9·3, axis 9, alt. testæ 11·2, lat. aperturæ, marg. incl., 7·2, alt. ap. 5·2 m.m.

*Hab.* Prope Moulmein, provincia Tenasserim.

A moderately large tumid and solid form, with rather flattened whorls and a prominent broadly conical spire; the first two whorls are generally quite smooth, the remaining transversely costulated, the ribs being on the last whorl a little more distant from each other, than on the previous ones; on the base they become quite obsolete.

Only a few specimens were found by Mr. Theobald at Yethebiankoo on the Attaran river, south-east of Moulmein.

**Streptaxis obtusus**, Stol., pl. vii, figs. 11, 12, 13, and pl. viii, figs. 1-4.

St. testa oblique ovata, tumida, apice obtusa, antice sensim attenuata, perforata; anfractibus 7, quinque superioribus regularibus, supra convexusculis, antepenultimo paulo obliquo, ultimo modice deviante, aperturam versus compressiusculo; periphæria in junioribus (fig. 13) rotundate subangulata, in adultis fere uniforme convexa; anf. omnium suturis impressis junctis, in superficie arcuatim conferte costulatis: costulis ad basin (in junioribus depressiusculam, in adultis convexiorem) obsoletis; umbilico ad marginem rotundato; apertura obliqua, postice (aut supra) lata et recta, antice (vel infra) fere uniforme angustatim rotundata; labio tenui, plica una parietali subcentrali instructo; labro incrassato, externo paulo arcuato, intus ad medium obsolete dentato, columellari rectiusculo, supra medium distincte dentato.

|                 | Adult fig. 11. | Jun. fig. 12. |
|-----------------|----------------|---------------|
| Diam. maj. .... | 10·4           | 9·3 m.m.      |
| „ minor, .....  | 7·2            | 6·4 „         |
| Altitudo, ..... | 9·6            | 7·8 „         |

*Hab.* Prope Moulmein, provincia Tenasserim.

This species is readily recognised from others by its remarkably obtuse, almost pupoid form, and comparatively regular growth of the whorls; there is a distinct tooth on the columellar lip present, and another tooth is generally also traceable on the opposite outer lip, though not so well defined as the former. In younger specimens the penultimate whorl is subangulate at the periphery and laterally somewhat projecting, but in older shells this angulation generally becomes less distinct and often quite disappears. The whole shell is densely costulated except at the base, where the ribs are only traceable in the umbilical cavity.

The animal is pale yellow with a beautifully yellowish red tinge on the upper anterior part of the body, which is, as usually, much longer than the posterior; the pedicles are also red, and the tentacles paler and very short; edge of mantle considerably thickened, whitish. Other details have already been recorded in my observations on the anatomy of the genus.

The species has been found on the limestone hills south of Moulmein, where it does not appear to be rare. Young specimens, as long as the whorls are regularly coiled, closely resemble Benson's *Helix bombax*, (Ann. and Mag. N. H., 3rd ser., III, p. 186), but they do not possess such a great difference between the longer and shorter diameter, as given by Benson of *bombax*, (no doubt a young *Streptaxis*), in which the inner whorls are much closer wound (compare Conch. Indica, pl. XXXI, figs. 1 and 4). An illustration of a young shell of *St. obtusus* is given on pl. vii, fig. 13; the peristome is slightly reflected.

5. STREPTAXIS SANKEYANUS, Bens., pl. vii, fig. 14.

1859, Ann. and Mag. Nat. Hist., 3rd ser., III, p. 472.—Hanley and Theobald, Conch. Ind., pl. viii, fig. 72.

The characteristic given by Benson is excellent; it is not necessary to repeat it. The species is readily known by its strong carina-

tion of the ante-penultimate whorl and its solid structure; it is waxy yellow when fresh and the fine costulation does not become obsolete at the base, as usual in other allied species. The largest specimen measures: diam. maj. 11, min.  $7\frac{1}{2}$ , alt. 8 m.m.

The figure in Hanley and Theobald's "Conch. Indica" does not appear to represent this species, but rather the next. The upper side of the penultimate whorl is never so gibbous and the aperture, I believe, never so truncate and biangular in front, as shewn in that figure; it is moreover always narrowly rounded.

The young shell consisting of the first 5 whorls is, as usually, quite regularly coiled, carinated at the periphery, and only distinguished from similarly formed species of *HELICIDÆ* by having the outer lip above always somewhat produced and peculiarly sinuous.

The animal is uniform pale yellowish white, often slightly more yellowish on the fore part of the body.

*Hab.* This species was met with only on the limestone hills at the so-called "Farm-caves," the original locality where it was described from.

##### 5. *Streptaxis Hanleyanus*, Stol., pl. vii, fig. 15.

*Streptaxis testa parva, oblique elongata, angusta, profunde ac late umbilicata, griseo albida; anfractibus  $6\frac{1}{2}$ , supra et infra striis filiformibus, arcuatis confertisque tectis, primis circ. quatuor, spiram sub-conoideam formantibus, regulariter involutis, antepenultimo ad peripheriam acute carinato, duobus ultimis valde deviantibus, et lateraliter productis; basi subangulato convexa; apertura fere rectangulariter elongata, angusta: labio parietali tenui, medio lamella valde projiciente instructo, labro paulo incrassato, undique reflexo, intus lævigato, supra prope suturam conspicuiter insinuatō; diam. maj. 7·5, d. min. 4·8; axis 3·5, alt. testæ 4·5; lat. apert. marginibus inclus. 4·2, alt. apert. 2·2 m.m.*

*Hab.* Prope Moulmein, ad flumen Attaran.

I have only lately received a single specimen of this interesting species through Mr. Theobald. It is allied to *St. Sankeyanus*, and it does not appear improbable that Hanley and Theobald's fig. 7,



on pl. viii., in the "Conch. Indica," rather represents the present species than the former, although it is very difficult to form a correct idea from such an insufficient illustration, as that given in the above quoted work. The form of the aperture and the natural size of the shell, noted by Hanley and Theobald, certainly do not in the least agree with Benson's *Sankeyanus*.

*St. Hanleyanus* is not only a smaller and more depressed shell, than the last, but it is very much narrower, with the last whorl more largely umbilicated, the aperture being also longer and more regularly rectangular. The whorls are finely costulated above and below in both species.

Genus. *ENNEA*, H. and A. Adams.

Sub-Genus. *HUTTONELLA*, Pfr.

If we consider *E. bicolor*, Hutton, as the type of *Huttonella*, this sub-genus includes a small number of *Ennea*, possessing a more or less sub-cylindrical form and four pliciform teeth in the aperture. Two of the teeth are placed at each side of the prosterior (or upper) angle of the mouth, producing a sort of a canal, in which terminates the pulmonary orifice and the anus. The columellar fold is peculiarly flattened and projecting, somewhat resembling the columellar expansion of *Clausilia*; the fourth tooth is usually small, situated at the base of the outer lip. Most characteristic are the two folds, or teeth, at the posterior angle of the aperture.

1. *ENNEA* [*HUTTONELLA*] *BICOLOR*, Hutton, pl. viii, fig. 7-8.

Pfr. Mon. Hel. Suppl. V, p. 456.

Burmese specimens from Rangoon and Moulmein are quite identical with those found about Calcutta and India generally, and the Ceylon and Mauritius form certainly does not differ specifically from them. Some shells appear to attain sooner their adult state than others, having the aperture perfectly developed with a length of only  $3\frac{1}{2}$  m.m., others grow up to 7 and 8 m.m. The identity of *Ennea bicolor*, with *E. mellita*, Gould, and *Ceylanica*, Pfr., can hardly be disputed. The supposed peculiarity, pointed out by Pfeiffer in the last named species, and referring to the shortness of the last whorl, is by no means constant in Ceylon and South

Indian specimens. The denticulations near the suture are generally distinct, but in large specimens they often become almost obsolete. I doubt even that Pfeiffer's *E. Pirriei* is anything more than a large *bicolor*. The short stout form called by Martens, (*Ost. Asiat. Moll.* p. 384), var. *abbreviata* I have obtained at Singapore; it has a thin, almost hyaline structure, but the whole character is, no doubt, that of *E. bicolor*.

The animal has a long body, laterally strongly compressed, posteriorly shortened, though on the whole a little more produced than in *Streptaxis*, more or less distinctly yellowish; on the head reddish; pedicles long, slightly thickened at the end, their external skin is yellow, but the internal eye-bearing peduncles are vermilion, eyes very small; tentacles small, pale reddish; mantle deep red, and so is also the whole of the internal lining of the shell which exhibits the same, deeper, or brighter red colour as soon as the animal moves about. When retracted only the median whorls appear as deep red. Boiling water changes in a moment the red colour to a greenish yellow, spirits of wine does it only gradually. The lateral line of the foot is rather distinct.

The mantle is only slightly swollen on either side of the pulmonary opening, rarely produced into a distinct lobe. The internal anatomy exactly corresponds with that of *Streptaxis*. The pulmonary cavity extends over the two last whorls when the animal creeps about; the distance can be well calculated by the position of the heart which lies at the base of the pulmonary cavity. The uterus consists of more deeply incised lobes than in *Streptaxis*. No jaw has been observed. The radula is very long, the sides curved up like a sheath of a bambú leaf. There are between 80 and 90 transverse series of teeth, arranged in a moderate curve. The centre tooth is short, sharply pointed with a rapidly widened base. The adjoining and following teeth are longer, slightly curved, sharply pointed and with a blunt knob near their bases; their size gradually decreases as they proceed outward. There are only 19 teeth in each transverse series (9—1—9).

The animal of *Huttonella bicolor* lives generally hidden under old wood, stones, and between damp gravel, particularly near the edges of tanks. Its movements are rather rapid. It is spread almost

all over India and Burma and the Malayan Peninsula. I have, however, not obtained it anywhere on the higher elevations of the southern slopes of the Himalayas, and it is probably also absent in the desert country of North-East India.

2. *Ennea* [*Huttonella*] *cylindrelloidea*, n. sp., pl. vii, fig. 4.

*Ennea* testa cylindracea, alba, apice obtusa, medio latissima, basi paulo contracta, anguste rimata; anfractibus 10, convexiusculis, suturis profundis sejunctis, primis tribus lævigatis, hyalinis, ceteris confertim transversaliter costulatis, ultimo ad basin rotundate carinato, prope aperturam dissoluto, paulum descendente; apertura paulo obliqua, rotundate ovata, marginibus expansiusculis circumdata, supra prope angulum posteriorem lamellâ obliquâ crassissimâ, intrante, valde coarctata, dente opposito in labro externo nonnunquam irregulariter mamillato; lamella parietali profunde sita. Altit. testæ 5, lat. ad medium 1·3; alt. apert. 0·9, lat. 0·8 m.m.

Animal lutescente albidum.

*Hab.* Damotha, prope Moulmein; provincia Tenasserim.

This is a very marked form of *Ennea*, readily distinguished from its allies by the cylindrical shape of the shell and the separation of the margins of the aperture from the previous whorl; in this respect resembling some of the West Indian *Cylindrellæ*. I found only very few specimens between the roots of plants near the limestone rocks at Damotha, N. E. of Moulmein; the species appears to be extremely rare.

*Fam.* PUPIDÆ.

*Pupa lignicola*, n. sp., pl. vii, fig. 3.

*Pupa* testa breviter tumide-ovata, subconica, cornea, vix rimata, apice obtusa; anfractibus  $4\frac{1}{2}$ , convexiusculis, costulis modice distantibus, transversalibus, paulo arcuatis, nonnunquam striis tenuioribus alternantibus, tectis, ad basin convecam obsoletis; apertura subrotundata: labio tenuissimo, levi; rarissime denticulo parvulo mediano instructo; labro externo tenui, paululum dilatato, edentulo, in anfractum penultimum vix ascendente; columella ad basin sensim expansiuscula, regionem umbilicalem tegente, torta, infra subdenticulata. Diam. maj. 1·5; d. min. 1·2; alt. 2 m.m.

*Hab.* Moulmein, provincia Tenasserim.

The animal is grey with somewhat, darker, very short pedicles and almost obsolete tentacles. The columella of the shell is at the base peculiarly expanded, flattened, somewhat twisted, producing at the lower part a small denticle. Out of a great number of specimens only one was met with which has a small tooth about the middle of the inner or parietal lip; its presence, therefore, must be regarded as an exceptional character.

The species was found on old masonry of the great Pagoda at Moulmein, and on the opposite bank of the river at Martaban on similar wooden structures.

**Hypselostoma Dayanum**, n. sp., pl. vii, fig. 2.

*Hypselostoma* testa minuta, conoidea, solidula, pallide brunnea, apice obtusiuscula, late profundeque perspective umbilicata; anfractibus 4, convexis, suturis profundis sejunctis, primo lævigato, submamillato, ceteris striis incrementi subobsoletis notatis, ultimo maximo, fere plane voluto, supra ad peripheriam subangulato, deinde sensim angustiore et ad marginem umbilici rursus obtuse angulato; apertura fere verticali, vix descendente, conspicuiter dilatata, subcirculari; marginibus junctis, intus crassiusculis et plicose dentatis; labio adnato modice expansiusculo, bidentato, dente superiore majore; labro six-dentato: dentibus duobus in regione columellari sitis subdistantibus, alteris duobus, in margine externo, similariter inter se remotis, sed duobus in marg. basali sitis approximatis, parvis. Diam. maj. 1·1, d. min. 0·8; altitudo 1 m.m.

*Hab.* Damotha, prope Moulmein.

A single specimen of this very interesting species was found together with *Georissa liratula*, *Diplommatina crispata* and *carneola*, &c., &c. on the limestone hill at Damotha. It is the third known species of the genus. In general form it resembles Blandford's *H. Bensonianum* from near Ava, but differs in the shape of the last whorl and in the dentition of the aperture. The latter is in both species almost vertical, not turned entirely upwards, as in the type of the genus, *H. tubiferum*. As regards form, the present species indicates still more distinctly the affinities of *Hypselostoma* to *Pupa*, than does *H. Bensonianum*.

I have not seen the animal of *H. Dayanum*, but that of *tubiferum* was noticed by Blandford, and observed by myself. The specimens I saw were pale grey; they had the eye pedicles rather more elongated than usually in species of *Pupa*, and more resembling those of *Helix*; the tentacles at the base of the rostrum were very minute, both blackish. The rostrum itself is thick and very minutely notched at the front edge. The foot is short, ovately elongated, roundly truncate posteriorly. The animal, when moving, carries its shell in a reverse position (see pl. vii, fig. 1). On the whole it greatly resembles that of *Anostoma*, as figured by Fischer in Journ. de Conch. for 1869, Vol. ix, pl. xi, figs. 1-2.

Fam. CLAUSILIIDÆ.

CLAUSILIA Drap.

A short time ago only very few species belonging to this genus were known from the Indian regions, but the number is considerably increasing. It is a noteworthy fact that nearly all the species at present on record characterize the so-called Malayan fauna. Several species were lately described by E. v. Martens and others from Sumatra and adjacent islands. I have two new species from Penang; one was recorded by Pfeiffer and Dunker from the Nicobars; a single specimen of a species, apparently identical with one from Penang, was obtained by me on the Andaman islands. From Burma *C. insignis* and *vespa*, Gld., *C. Philippiana* and *Gouldiana*, Pfr., *C. bulbosus*, Bens., *fusiformis*, Blf., and *tuba*, Hanley (Conch. Indica, pl. xxiv, fig. 9,) were made known. Theobald described *Cl. Masoni*, which with the last mentioned species, belongs to a peculiar type of *Clausilia*, having as its close ally Troschel's *Cl. Peruana*, classed by H. and A. Adams and Albers in the subgenus *Nenia*. Mr. Theobald also obtained about Moulmein and in eastern Pegu several as yet undescribed species. From the Khasi hills, Benson described *Cl. loxostoma*, and *C. bacillum* of Benson was recently figured in the Conch. Indica. There are, however, at least three other species\* from the same regions, mostly collected by Major Godwin-Austen. *Cl. Jos*, Bens., is from Darjeeling, while *Cl. cylindrica*, Gray, is as yet the

\* These and other new species will be described by Mr. W. Blandford, in his forthcoming Monograph of the Indian species of this genus.

only species which extends along the Southern slopes of the Himalayas westwards into the Sutlej valley.

As no anatomical account has yet been published of any of the Indian species, I shall give a few details of *Cl. Philippiana* which, with *Cl. bulbosus*, (? *vespa*), and a small form allied to *Philippiana*, represents a peculiar little group of vespiform *Clausilia* from the neighbourhood of Moulmein.

CLAUSILIA [PHEDUSA] PHILIPPIANA, Pfr., pl. vi, fig. 7-10.

Mon. Hel., vol. ii, p. 423; Küster. Syst. Conch.-Kabinet, *Clausilia*, p. 100, pl. xi, fig. 7-9.

Without Küster's figure it would be difficult to identify Pfeiffer's species, that author's description being in several respects barely sufficient. Pfeiffer says regarding the 6 whorls "primi 3 palaniusculi;" this is strictly speaking not the case; it is the apex which is invariably obliquely flattened or obtuse, but all the whorls are distinctly convex, and the three upper ones almost more so than the following. The top, or embryonal whorl becomes quite solid in adults. Further on, Pfeiffer says: "plica subcolumellaris immersa," while that fold is perfectly distinctly traceable in the aperture.

There are 7 or 8 palatal ribs on the outer lip, the uppermost below the suture is the longest, the following short. The lower palatal plaits become less distinct in old specimens, than they are in the adolescent horny and transparent shells, but they never appear to become obsolete. The other characters relating to the structure and the dimensions, noted by Pfeiffer, agree well with the Moulmein shell, except that the oblique longitudinal diameter of the aperture is rarely 7 m.m.; usually it is only 6½ m.m. in specimens the total height of which is 21 m.m. Pfeiffer's reference to the relation of *Cl. Philippiana* with *insignis* is not well chosen; few shells could be more different than these two; but judging from the description of Gould's *Cl. vespa*, this form must be very closely allied to *Philippiana*. The description is brief, but there is strictly speaking nothing in it which could not equally well apply to the last named species.

A very closely allied species has also lately been obtained by Mr. Theobald at Nattung, on the Attaran river, near Moulmein.

It has quite the form of *Philippiana*, but is one third smaller, has one whorl less and the last whorl is comparatively a little more stretched. It appears to be a constant form and will probably deserve a separate specific name.

*Hab.* Common at the Farm-caves near Moulmein on limestone hills.

The animal of *Cl. Philippiana* is black with a greenish tinge on the posterior part of the body, which is covered with rather coarse warts; the pedicles are moderately elongated, pinkish, slightly swollen at the tips which bear the small eyes centrally; tentacles very short, but distinct; foot moderately elongated, strong, posteriorly obtusely pointed.

The clausilium is thin, white, somewhat broader than the expanded, and also white, portion of the columella, on which it reclines when the animal protrudes out of its shell. When closed, the external edge of the clausilium rest on the palatal folds; this appear to have the object of preventing the shell being closed hermetically, that is, to admit a little air even when the animal has retracted the body in the shell, which it can do far behind the clausilium.

The mantle has a free entire edge, and is internally somewhat thickened, especially on either side of the pulmonary orifice. At the place of the labial fold the edge is simply grooved. Corresponding to the columellar rib the groove is much stronger and deeper, extending with free raised edges to the mantle-margin. The lower (or anterior) of these lamellar edges is semicircularly enlarged, and towards the end folded over; it secretes the columellar fold, with its internal laminar projection for the support of the clausilium. The upper (or posterior) edge is smaller and evidently secretes the clausilium; it becomes folded over the former when the animal protrudes out of its shell.

As regards the internal structure there is nothing very distinct from the anatomy of the HELICIDÆ, as may be seen by a comparison of figure 8 on pl. vi, and the explanation accompanying it.

The pulmonary cavity is narrow and long, the mantle forming it being rather thick and of a deep pinkish black colour. The kidney is of a large sub-triangular form, and one portion of it almost entirely envelopes the heart. The mouth is small and the

salivary glands lie immediately behind it, covering the anterior part of the alimentary canal, while in most *HELICIDÆ*, they are on long peduncles and situated at the lower anterior base of the stomach. The oral parts and the salivary glands are pinkish grey. The intestines make only a slight bent and the rectum is accompanied by a very narrow albuminous gland, along which also the duct leading from the kidney appears to lay.

The retractor muscle of the body is divided in two very broad and strong parts; they are attached to the anterior end of the food, below the mouth, and divide posteriorly again into several thin branches. The retractor muscles, supporting the buccal parts, are shorter and also bipartite. The nervous ganglion ring lies immediately behind the mouth and is covered up by the anterior part of the salivary glands; it is very thin and gives only a few very thin branches to the lips, the pedicles and to the generative organs. The small extent of the nervous system is very striking, as compared with the same organs in the *HELICIDÆ* and *ZONITIDÆ*.

The generative organs fill the anterior part of the body nearly entirely. The uterus is comparatively thin, of grey colour; the albuminous gland (alg), attached to it, very large, nearly as long as the uterus, and more than double its thickness. The receptaculum seminis (rs) is an oval pedunculated gland, laying either along the uterus, or obliquely across the body, a short distance below the hermaphrodite opening, enveloped in soft tissue. It is provided with a long appendage, attached along the uterus, and equal in length to it. This appendage (ad) contains an orange coloured, tough flagellum, filled with a whitish substance, and possibly represents, the arrow (or amatorial) sac.

I have not observed the presence of spermatozoa in the so-called 'receptaculum seminis;' it was filled with flattened transparent bodies and some colouring matter. The vas deferens branches off about half way from the uterus, makes a few twists, attaches itself to the tissue just below the hermaphrodite opening, and then shortly after becomes thickened, being at this place fixed with a small and thin retractile muscle. The penis makes three distinct twists, or almost coils; it is very long and the terminal half is more thickened than the other; it ends with a thin flagellum.



The jaw is semilunar, narrow, thin, concentrically very finely, and radiately distantly and indistinctly, striated, the anterior concave edge is nearly perfectly entire.

The radula is long, moderately narrow, consisting of about 80 transverse, slightly angular series of teeth, there being 53 teeth in each series. The centre tooth is smaller than the adjoining, with a simple, inflected and pointed tip; it is contracted towards the base. The 14 inner laterals are longer and stronger than the 12 outer laterals. They are all tri-cusped; at first the median cusp is by far the largest, gradually, the lateral increase in size, while at the same time the median cusp decreases, until on the outermost lateral teeth the three cusps are almost equal. On the whole the form of the teeth agrees better with that of the *HELICIDÆ* than with the *ZONITIDÆ*. The dental formula is  $12 + 14 - 1 - 14 + 12$ .



ON A QUANTITATIVE METHOD OF TESTING A "TELEGRAPH EARTH,"—  
by W. E. AYRTON, Esq.

[Received and read 6th April, 1871.]

The method that has been used up to the present time for testing a telegraph "earth" has been a qualitative method only, that is to say, although it may in a rough way have answered the question, is an "earth" good or bad, it was quite unable to give any answer to the question, how good or how bad.

In Europe the ordinary way to make an "earth" is to use the iron gas, or water pipes, but in most places in India such pipes do not exist, so that some large piece of metal has to be buried for this purpose. A coil of iron wire, a piece of an iron post, or a copper plate have been used at different times. Now as the nature of the ground in the immediate neighbourhood of this buried piece of metal greatly affects its electrical utility, it becomes a question of great practical importance to determine in absolute units the resistance of the "earth" used in each particular case.

The following method devised by Mr. Schwendler is at present in use in the Indian Telegraph Department.

PLATE XV.

Figs. 1—3. *Plectopylis achatina*, Gray, p. 217 et seq.

1, general anatomy; 2, jaw; 3, different teeth of one transverse series.

Figs. 4—6. *Plect. cyclaspis*, Benson, p. 217 et seq.

4, genital organs; 5, jaw; 6, various teeth of a series.

*ft.* foot; *a*, anus; *l*, lungs; *mt*, mantle; *rm*, retractile muscle of the foot; *p*, penis; *oe*, oral parts; *sg*, salivary glands; *roe*, retractor of the oral parts; *m*, retractor of the penis; *sgl*, supposed arrow gland; *al*, alimentary canal; *rs*, seminal receptacle; *li*, liver; *alg*, albuminous gland; *hd*, hermaphrodite duct; *hg*, hermapt. gland; *i*, intestines; *st*, stomach; *k*, kidney; *h*, heart; *pg*, pigment gland; *vd*, vas deferens; *ut*, uterus; *eg*, eggs in the uterus; *pr*, prostata, *ho*, hermaphrodite opening.

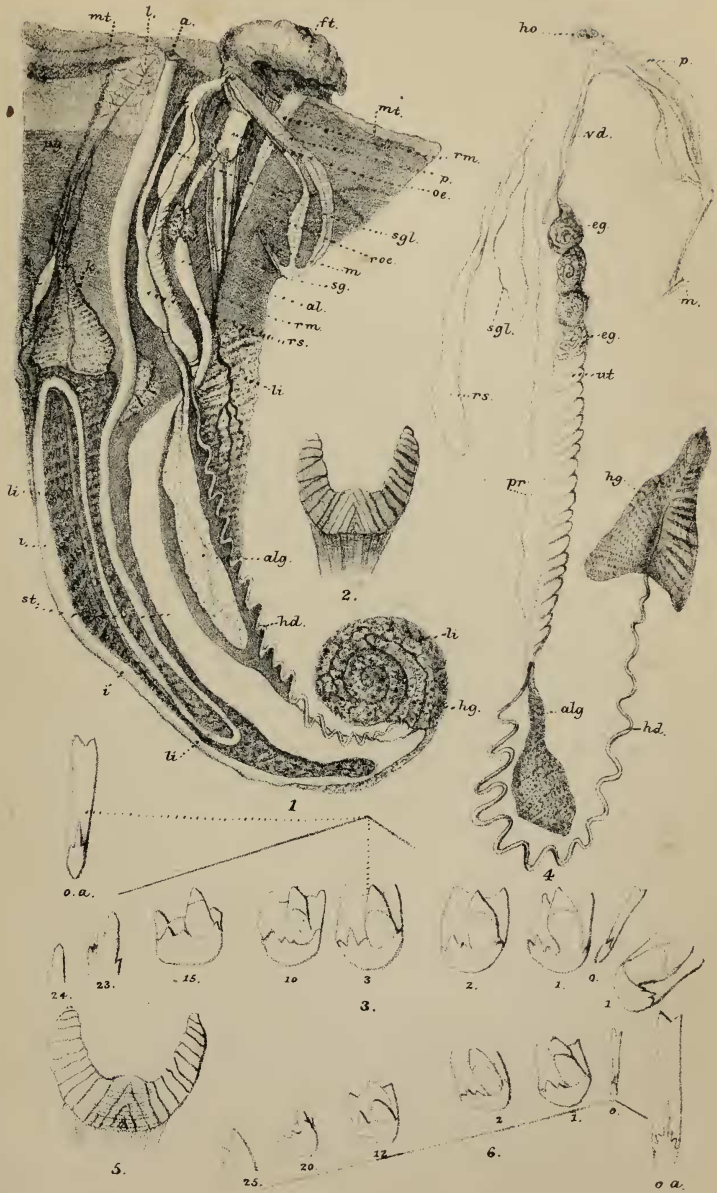


PLATE XVI.

Figs. 1—3. *Trachia delibrata*, Benson, p. 225.

1, genital organs ; 2, jaw ; 3, various teeth of one transverse series.

Figs. 4—10. *Sesara infrendens*, Gould, p. 242 et seq.

4, genital organs of a young specimen ; 5, the same of a full grown specimen ; 6, horny organ situated in an appendage of the oviduct, enlarged ten times the natural size ; 7, a transparent, horny, bearded thread, connected with the appendage represented in fig. 6 ; 8, similar threads, as seen in fig. 7, but not bearded ; 9, jaw ; 10, different teeth of one transverse row.

*ho*, hermaphrodite opening ; *p*, penis ; *m*, retractor muscle ; *ut*, uterus ; *rs*, seminal receptacle ; *hd*, hermaph. duct ; *alg*, albuminous gland ; *vd*, seminal duct ; *c*, calciferous sac ; *f*, flagellum ; *w* upper and *w'*, lower end of the peculiar horny appendage of the oviduct ; *n*, place where the end of the horny appendage was originally situated.

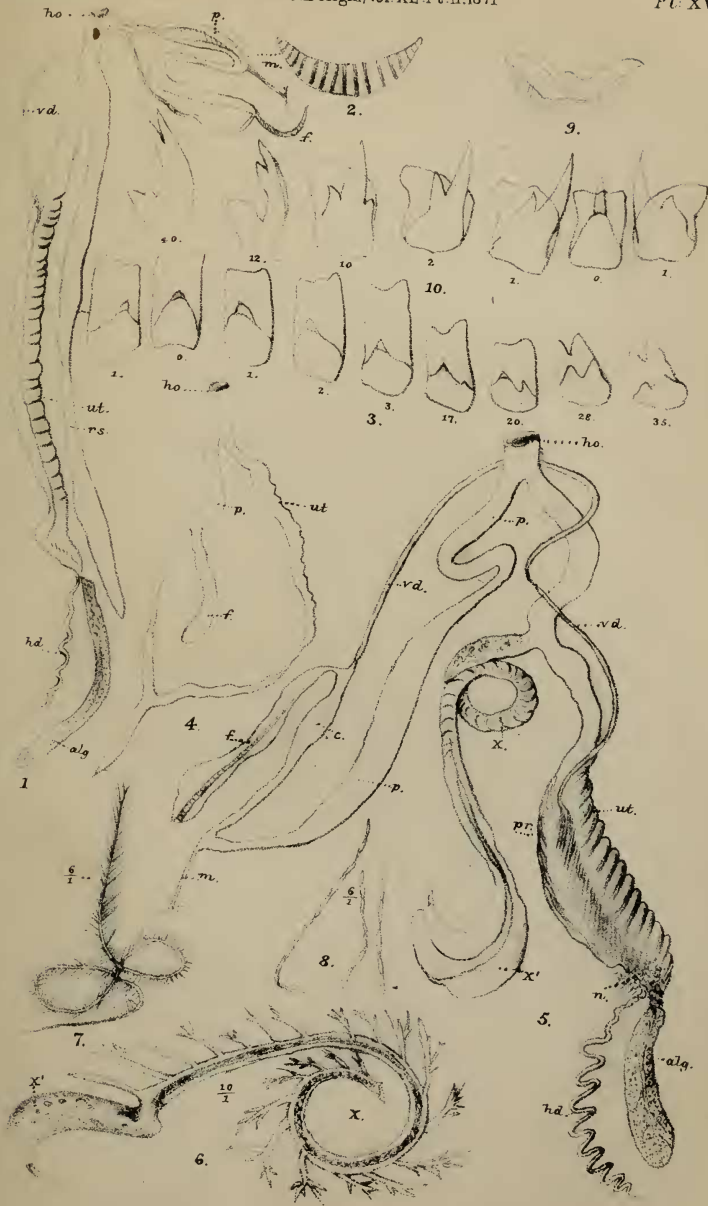


PLATE XVII.

Figs. 1—5. *Rotula anceps*, Gould, see p. 233 et seq.

1. General anatomy, 2, diagrammatic view of the various lobes of the mantle, enlarged; 3, genital organs; 4, jaw; 5, teeth, all enlarged (see p. 236).

Figs. 6—14. *Macrochlamys* [*Durgella*] *honesta*, Gould, p. 248 et seq.

6, normal form; 7, Pegu variety; 8, abnormal variety from Moulmein, (comp. p. 248); 9, variety from near Moulmein; 10, jaw; 11, peculiar solid, horny threads from the genital organs; 12, solid particles out of the bag marked *x* in fig. 13, which is a peculiar appendage of the genital organs; 14, various teeth; all objects represented in figures 10—14 are greatly enlarged.

*f*, foot; *fg*, foot gland; *a*, anus; *r*, rectum; *ag*, amatorial gland; *al*, albuminous gland accompanying the rectum; *li*, liver; *i*, intestines; *st*, stomach; *sg*, salivary glands; *h*, heart; *k*, kidney; *pg*, pigment gland; *l*, lungs; *oe*, oral parts; *lsl*, left shell lobe of mantle; *lsl'*, lower end of the same; *rsl*, right shell lobe; *rsl'*, lower end of the same; *rdl*, right dorsal lobe; *ldl*, left dorsal lobe; *p*, penis; *p'*, enlarged portion of the same; *cd*, calciferous gland; *fl*, flagellum; *vd*, vas deferens; *fa*, sessile gland of the oviduct; *rs*, receptaculum seminis; *ut*, uterus; *pr*, prostata; *hd*, hermaphrodite duct; *hg*, hermaphrodite gland; *alg*, albuminous gland; *m*, retractile muscle; *ho*, hermaphrodite opening.

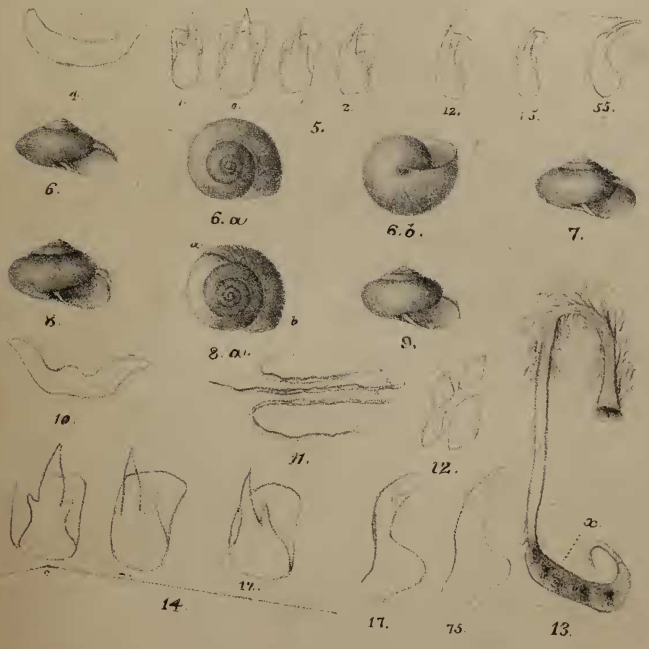
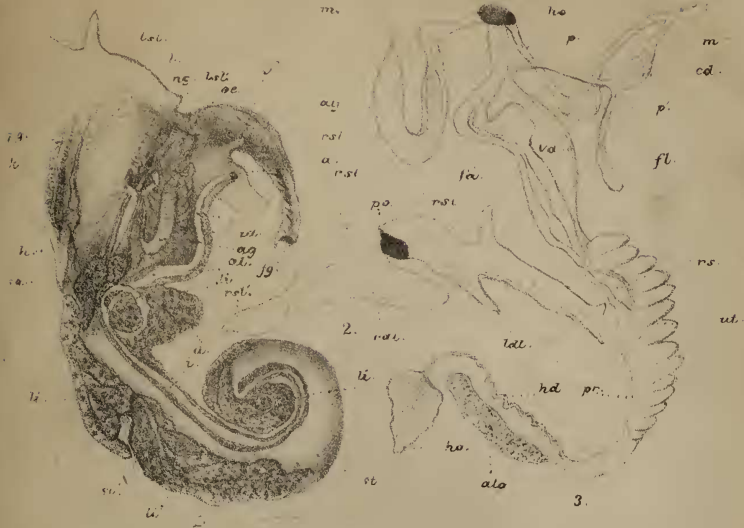


PLATE XVIII.

Fig. 1—4. *Conulema ategia*, Benson, p. 237.

1, genital organs; 1a, section of the amatorial gland; 2, diagrammatic view of the mantle lobes; 3, jaw; 4, different teeth of one transverse series.

Figs. 5—9. *Conulema infula*, Benson, p. 239.

5, side view of an animal, from Calcutta; 6, genital organs during the winter season; 7, anterior portion of the same during the rainy season; 8, jaw; 9 various teeth of one transverse series.

Fig. 10, *Conulema liricineta*, Stol., p. 241.

Figs. 11—13. *Microcystis molecula*, Benson, p. 251.

11, genital organs; 12, jaw; 13, a few teeth from a transverse series.

*ag*, amatorial gland; *ho*, hermaphrodite opening; *m*, retractor muscle; *p*, penis; *ps*, calciferous sac; *vd*, vas deferens; *pr*, prostata; *ut*, uterus; *hd*, hermaphrodite duct; *hg*, heramph. gland; *alg*, albuminous gland; *rs*, receptaculum seminis; *ov*, enlarged ovary sac; *rsl*, right shell lobe of the mantle; *rsl'*, lower end of the same; *lsl*, left shell lobe; *lsl'*, lower end of the same; *rdl*, right dorsal lobe; *ldl*, left dorsal lobe;  $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\delta$ , successive layers in the section of the amatorial gland, (fig. 1a).



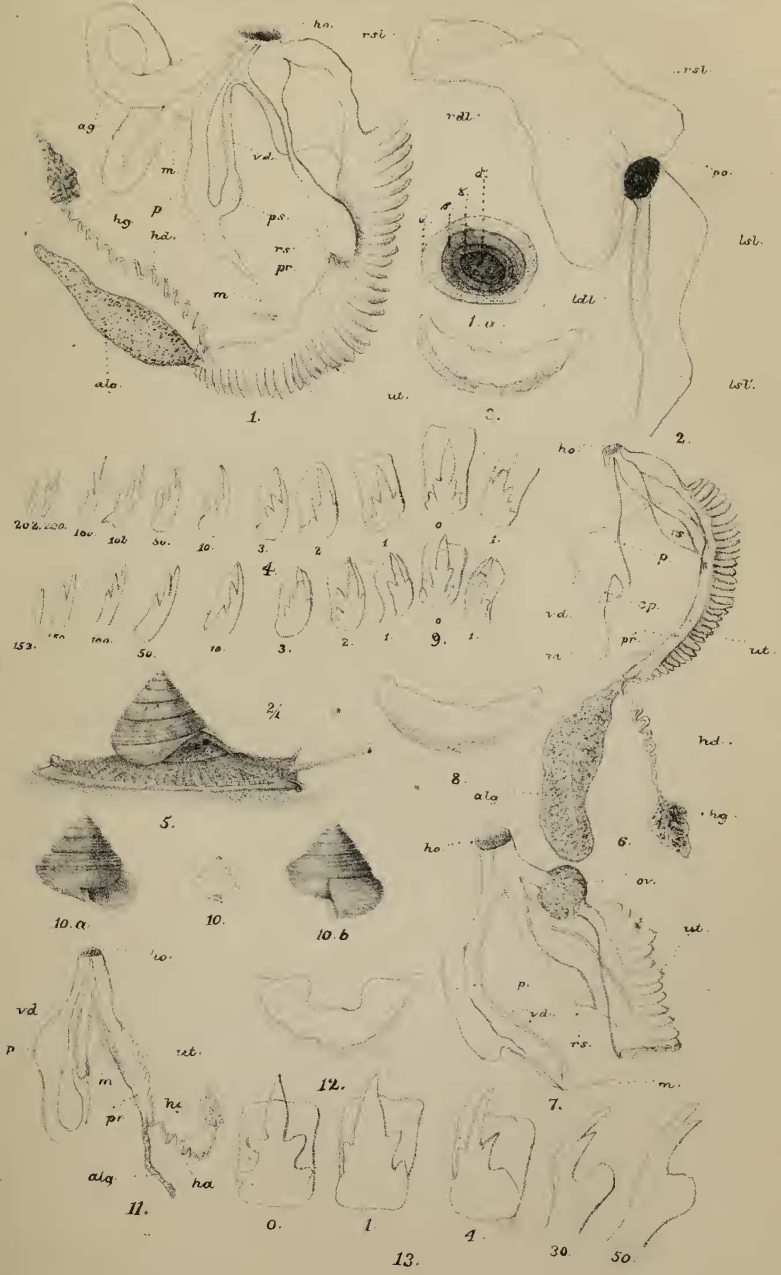


PLATE XIX.

Figs. 1—4 and 7—9. *Sophina calias*, Benson, p. 255.

1, general anatomy; 2, genital organs; 3, 3a, jaws; 4, a few teeth of a transverse series, the 5th and 14th tooth shewn in a lateral view; 7, typical specimen, front, side and upper views; 8, var. *schistostelis*, same views; 9, a specimen with irregularly thickened peristome.

Fig. 10. *Sophina forabilis*, Benson, p. 257.

10a, the front view, is enlarged twice the natural size.

Figs. 5, 11, 12, *Sophina discoidalis*, Stol., p. 258.

5, jaw; 11, a much depressed specimen, natural size; 12, a somewhat elevated specimen; figs. 12a, 12b, 12c, are enlarged.

Figs. 6 and 13. *Sophina conjungens*, Stol., p. 259.

6, jaw; 13, different views in natural size.

oe, oral parts; *t*, tentacles; *ep*, eye-pedicles; *a*, anus; *kd*, kidney duct; *mt*, mantle; *lml*, left shell lobe; *rml*, right shell lobe; *sg*, salivary glands; *n*, ganglion; *ao*, aorta with the branches *lh* and *bg*; *st*, stomach; *k*, kidney; *h*, heart; *l*, lungs; *r*, rectum; *m*, retractor; *cp*, calciferous sac; *vd*, seminal duct; *rs*, seminal receptacle; *p*, penis; *gs*, amatorial gland; *ho*, hermaphrodite opening; *pr*, prostata; *ut*, uterus; *hd*, hermaphrodite duct; *hg*, hermaphrodite gland; *ag*, albuminous gland.

